AMATEUR WORK

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HOW TO MAKE A TELEGRAPH RELAY.

R. C. Browne.

A relay, carefully made according to the following directions, will prove a serviceable and extremely sensitive apparatus, suitable for many experiments in wireless or line telegraphy. The general construction is shown in Fig. 1, A being a piece of brass $\frac{1}{2}''$ x $\frac{1}{4}''$ and $6\frac{1}{2}''$ long. It is bent in a vice as shown, the several angles being made as accurate as possible. Drill a $\frac{1}{4}''$ hole at a, which should be countersunk to receive the head of a brass screw, which holds the rod to the base, and another $\frac{1}{4}''$ inch hole at b. Drill $\frac{1}{8}''$ or $\frac{3}{16}''$ holes at c and d, which should be threaded to receive the thumb-screws e and f. See that the threads are the same in the hole as on the thumb-screws, the latter being the top screws from two binding posts, though brass machine screws may be used. The thumb-screw e should have a small piece of platinum soldered to the end, and the end of f should be covered with a piece of thin cardboard or rubber. The rod A is then screwed to the center and at one end of the base board B, which should be of hard wood $\frac{7}{8}''$ thick, 5″ wide and 7″ long.

For the magnet M there will be needed a piece of soft Norway iron C, $1\frac{1}{2}''$ x $\frac{1}{2}''$ x $\frac{3}{16}''$. Drill three $\frac{1}{8}''$ holes h through it, one in the center and one $\frac{1}{8}''$ from each end. The hole in the center is threaded to receive the $\frac{3}{16}''$ machine screw D. The cores E are round, soft bar iron, $\frac{3}{8}''$ diameter and $2\frac{1}{16}''$ long. In one end of each core drill holes, and thread them to receive a machine screw (g, Fig. 2).

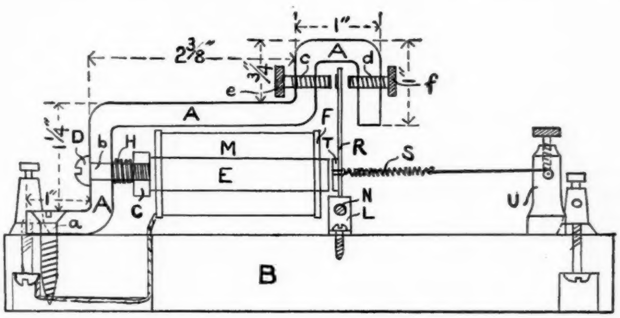

Fig. 1.

After the cores are wound with wire they are fastened to the ends of the iron yoke C by these screws, thus forming a horseshoe magnet. Another way of fastening the cores to the yoke is to have the core pieces $\frac{1}{4}''$ longer, file down this extra length so that it will snugly fit the hole in the end of the yoke, and rivet firmly in place.

The cores being prepared, they are fitted at each end with round, hard rubber or fibre washers F, $\frac{3}{16}''$ thick and 1″ in diameter, the hole in the center being $\frac{3}{8}''$. These washers are held in position by shellac or glue, thus forming two spools for holding the wire. The wire should be No. 36 cotton covered magnet wire. First cover the cores with three thicknesses of firm writing paper laid on with shellac. Bore a small hole in the rubber washer, on the yoke end, to receive the inside end of the wire, about 3″ being left outside for connections. Wind the wire in even layers until the coil is nearly 1″ in diameter. Coat each layer with shellac, and use great care to prevent

kinks or breaks in the wire. One coil is wound in the opposite direction to the other, so that the poles will not be the same. Cover the outside of the coils with a layer of dark-colored paper or binding leather, both for appearance and protection; then fasten to the yoke, and connect the inside ends of each coil. The magnet is then complete, and should be placed in position on the brass standard A, as shown in Fig. 1. A compression spring H, about $\frac{1}{4}''$ long, is fitted over the screw D, between the frame A and the yoke of the magnet. This allows the position of the magnet to be adjusted. The outside ends of the coils are carried through two holes bored in the base-board to the screws holding the binding-posts, which have been placed one in each corner of that end of the base-board, as shown in Fig. 1.

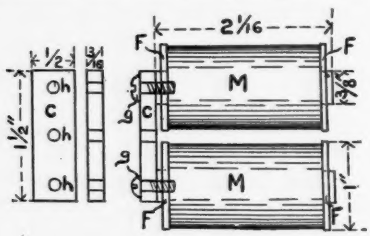

FIG. 2.

The armature or moving lever next demands our attention. Exceptional care must be taken in making it, as it is a very important part of the instrument. Obtain the works of an old clock of the square frame kind. These may generally be obtained from any clock repairer for the asking, the writer having secured about a dozen works recently at one place. Cut out with a knife-blade file that part of the frame having the bearings for the balance wheel (see J, Fig. 3). Save the balance wheel K, Fig. 3, shaft and bearings, to form the pivot for the armature. With a flat file smooth the edges of the pieces of the frame, and then bend them as shown at L, Fig. 3. Use care to have the centers of the bearings N exactly the same height above the base-board. Drill $\frac{1}{8}''$ holes in the parts resting on the base, to receive the screws O.

Remove the rim and spokes of the balance wheel, and cut a slot in the brass hub P, into which solder the wider end of a wedge-shaped piece of sheet brass R, $\frac{1}{16}''$ thick, $\frac{5}{8}''$ wide at the base, $\frac{1}{4}''$ wide at the top, and $1\frac{1}{2}''$ long. At a point directly opposite the cores in the magnet drill a hole in the piece R, and rivet on a piece of soft iron, T (thick stove-pipe iron will answer), $\frac{3}{8}''$ wide and $1\frac{1}{2}''$ long. Under the head of the rivet twist a short piece of steel wire, the end projecting to form a small hook, to which is attached the spring S. Mount the armature on the base-board so that the iron armature, T, will be directly opposite the cores of the coils and the shaft of the balance wheel moves easily but not loosely on the bearings N. Mark the point at the top of the lever R, where the thumb-screw e touches, and solder a small piece of sheet platinum, being sure to get it on the proper side of the lever.

The regulator for regulating the tension of the spring S, which holds the lever away from the magnets, is easily made. A large binding post, U, is placed as shown in Fig. 1, with the hole parallel to the armature and the post a little to one side of the center. Through the hole in the post put a piece of brass wire to one end of which has been soldered a round head so that it may be carefully turned. Make a small, light spring, S, by winding No. 30 brass wire around a wire nail, with a hook at each end. One end is placed on

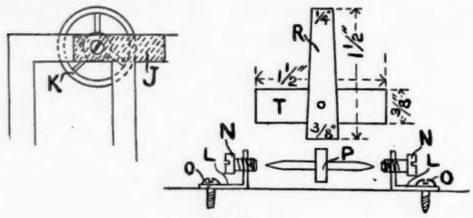

FIG. 3.

the hook of the armature and the other is fastened by a short length of silk thread to the brass wire in the binding post. To adjust the tension, turn the wire in the binding post, winding or unwinding the thread until the correct tension is obtained, then fasten with the screw in the binding post. Two binding posts are screwed to the remaining corners of the base-board, one of them being connected by No. 14 or 16 covered wire to the brass frame A, the other to one of the bearings N, holding the pivot R. These connecting wires are carried through holes bored and grooves cut on the under side of the base-board.

AN ELECTRIC INDICATOR.

William Slyke.

In a house where there are several entrances and rooms, and electric connections are desired to ring a call bell, an instrument called an annunciator or indicator is used. Bells of different tone are sometimes used, but when the number of bells is more than three or four, it is very hard to distinguish between them. An indicator, which shows from what room or place the call comes, is desirable. Indicator movements take a variety of forms, but may be divided into two distinct forms, viz.: Those which drop a shutter or move a disc, in which the shutter or disc requires to be reset each time a signal is sent in; and those which require no resetting, depending for their action on a swing or pendulum movement, which, when started, continues for some time. The latter kind are called pendulum indicators, and is the kind to be here described.

Of the two kinds, the pendulum indicator is much to be preferred, as an extensive use of the former has proved that persons cannot be relied upon to replace the shutter, so that when the bell rings there are two or more shutters down, thus causing more or less delay in answering the call. As there are a number of magnets used in the construction of an indicator, the builder is advised to buy the magnets, as they will be cheaper to buy than to make; but if one wishes to make them, a full description will be found in the November, 1901, number of Amateur Work.

A magnet is needed for each call, to be connected to the indicator, and another for a relay. (See Fig. 1.) Two magnets are fastened to a soft iron base, L, Fig. 1. One or two magnets may be used, but two are better. A piece of soft iron about $\frac{1}{8}''$ in thickness by $\frac{1}{2}''$ wide, and just long enough to reach from one end of one core to the end of the other core of the magnets (M, Fig. 1) forms the armature. To the top of the armature solder a very thin piece of steel or other springy metal, about $1\frac{1}{4}''$ long and $\frac{1}{8}''$ wide (N, Fig. 1). A binding-post, J, with a hole and set screw, is inserted into base B of the indicator. The end of the steel spring is made small enough to fit tightly in the hole of the binding-post. To the other end of the armature is soldered a piece of stiff wire about $1\frac{1}{4}''$ long. To the end of this wire is soldered a piece of tin or other light metal, about $1''$ long and $\frac{3}{4}''$ in width; this is the vane upon which the name or number is placed. In many of the commercial forms a piece of silvered glass (looking-glass) is fastened to the wire instead of metal, as this can be readily seen in a dim light.

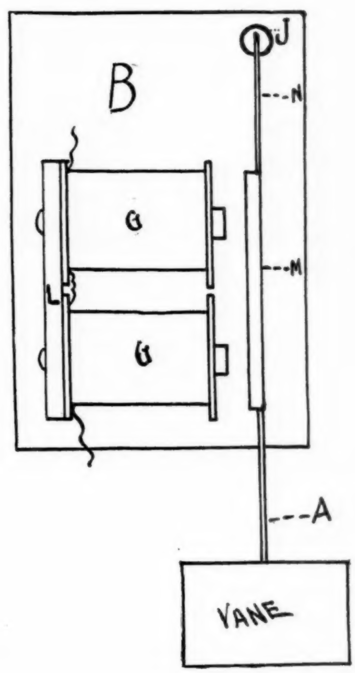

Fig. 1.

Push the end of the spring in the binding-post until it just reaches the other side of the hole, and fasten it down with the screw. The binding-post is put in a position so that the armature hangs as shown in Fig. 1. The armature should hang $\frac{3}{8}''$ from the top of the cores of the magnets. Now

test the vane by fastening it in a vertical position so the vane hangs down. Connect one wire of the magnet to the pole of a battery; the other end of the wire is just touched to the other pole of the battery. As soon as the second wire comes in contact with the battery the armature will, if the vane is all right, be attracted to the magnet G G and held there until the circuit is broken. As soon as this occurs the vane and armature is released and will swing to and fro for some time, finally stopping in its normal position. Make as many of these vanes as there are rooms or other places to be connected with the indicator; three are shown in Fig. 2.

may be fixed the same way as the armature of the vane. To the other end of the armature is soldered a strip of metal 1¼″ long and ¼″ wide, and should be as thin as a medium-sized clock spring. Two binding-posts with small holes and set screw are inserted in the base, as shown at B and C in Fig. 3. To the post B is fastened a piece of wire 10″ or 12″ long, No. 20 gauge, to be used for connections. A piece of a wire nail ¼″ in length is inserted in the hole of each binding-post, the top screw is then screwed down to firmly hold the nail. It is very important that there should be only a very small space between the armature and the cores of the magnet, and the metal strip should

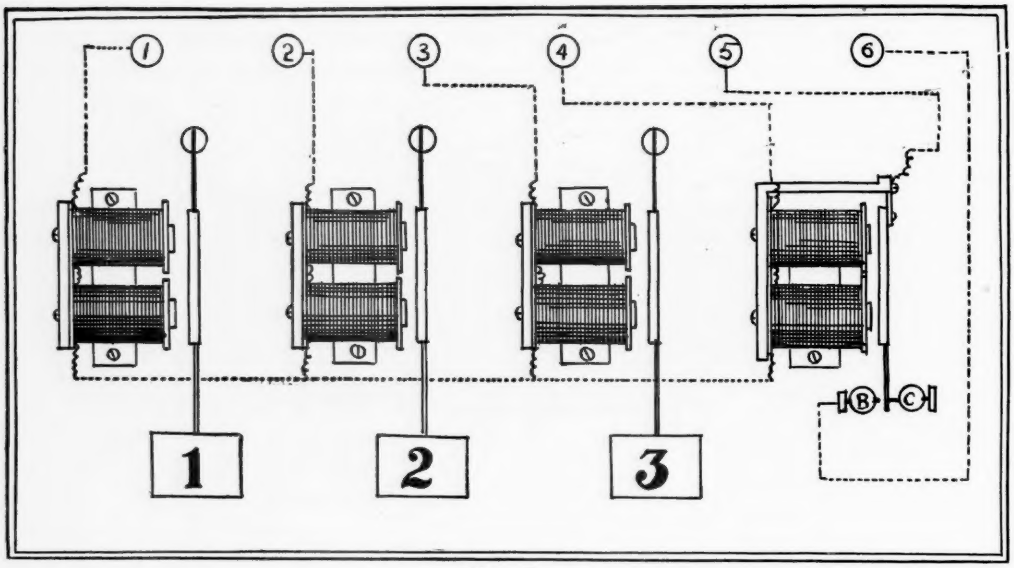

Fig. 2.

rest lightly against the post C but not quite touch the post B when the relay is at rest. If a speck of platinum can be soldered to the nail in post B, and another speck on the metal strip just where the strip touches the nail, a better contact is made, but if all the parts are kept clean it is not absolutely necessary.

As an electric bell is used with the indicator to tell when a signal is sent in, a relay is frequently employed in conjunction with the pendulum indicator, as the continual make and break of the circuit by the bell sometimes interferes with their satisfactory working. As its name implies, it relays another battery into the circuit. A relay is used in telegraphy and many other forms of electrical apparatus. It is made as follows: A magnet is fastened to a soft iron base just like the vane. The armature is made also in the same manner as the armature of the vane. It should be pivoted at the top, as shown at J, Fig. 3, but

A piece of planed board is now procured, large enough to hold all the vanes and the relay. Three binding-posts are needed for the relay, and one for every vane put on the board, as shown in Fig. 2. The inside connections are as follows: Fasten all the vanes to the board, and place the

relay in the right-hand side as in Fig. 2. From post B of the relay a piece of annunciator wire is brought to binding-post 6, Fig. 2. A piece of wire is soldered to the armature of the relay and carried to post 5. The end of the lower magnet wire of the r elay is connected with the bottom wire of each vane magnet. (See Fig. 2.) The upper wire of magnet on the relay is carried to post 4, and the upper magnet wire of each vane is carried to a separate binding-post. The outside connections can be readily seen by examining Fig. 4. Post 6 is connected to post on bell. A piece of wire is carried from zinc of battery to the other post of the bell. A wire is carried from post 5 of indicator to carbon of battery Z. The connections of battery X are: Carry a piece of wire from zinc of battery to post 4; from carbon of battery carry a length of wire to each push-button in the different rooms, and from push 1 a piece of wire to post 1 on indicator, etc.

holds it until the push is released, when the armature is released also and begins swinging. The armature of the relay is also attracted, and in coming to the magnet it brings the metal strip in contact with the nail in post B; this closes the circuit of the bell, which rings until the push is released.

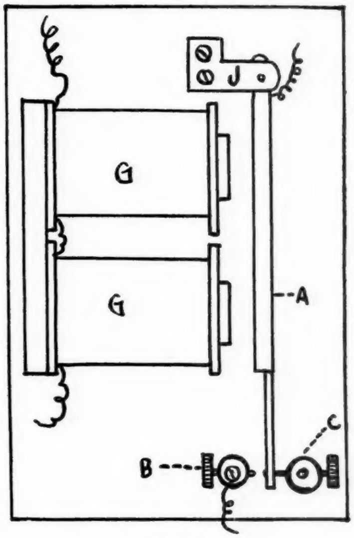

FIG. 3.

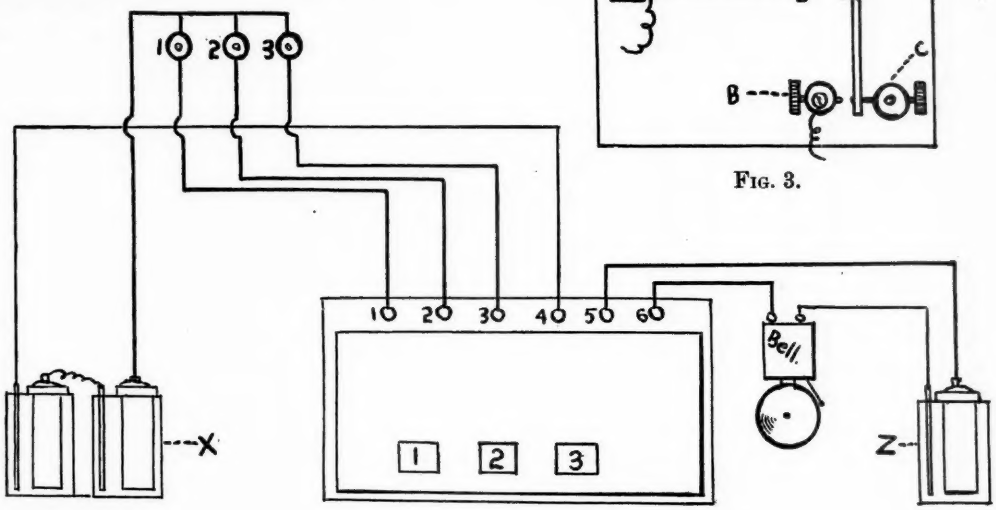

FIG. 4.

A top can be put over the vanes and relay with holes through which to see the numbers of the rooms. If a single-stroke bell is used, a relay is not necessary, and the bell is connected just like the relay, cutting out the wires of binding-posts 5 and 6. The working of the indicator is as follows: A person in room 1 pushes the button in that room, this closes the circuit of vane 1 and the relay. The magnet attracts the armature and

In the construction of a municipal electrical generating plant for the city of Geneva, Switzerland, the engineers found themselves confronted with a great difficulty in the constantly-varying water level of the river Rhone. In order to overcome this inconstancy of the water supply, a two-story station was constructed, with two turbines built one above the other on the dynamo shaft. The plant comprises 18 sets of these turbines.

STUDIES IN ELECTRICITY.

XI. PARTS OF THE DYNAMO.

As mentioned in previous chapters, the field of a dynamo provides the lines of magnetic force in which the coils of the armature revolves, cutting these lines of force and thus generating an electro-motive force. In the earliest forms of dynamos permanent magnets were used for the field, but these have long been discarded, except in the smallest sizes and for special purposes, such as the magnet ringing device of the telephone, spark generators for gas engines, and the hand-power dynamo of the laboratory. In these forms of the dynamo the permanent magnet is used, but in the larger forms of direct-current machines the fields are self-excited electro magnets.

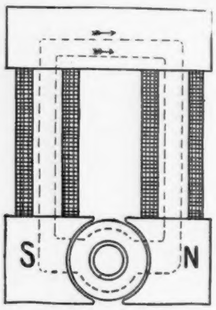

FIG. 30.

The designs of the different manufactures differ greatly in form, the aim in all being to secure an easy and short path for the flow of the magnetic lines of force in as compact and cheaply constructed a form as possible. The work to be done also regulates to quite an extent the design of a dynamo. A complete magnetic circuit must be provided to secure a flow of the magneto-motive force (M M F), just as a complete outside circuit is necessary to the flow of the electric current. This is shown in Fig. 30, which is an upright horseshoe type of single circuit bipolar field magnet, the magnetic circuit being shown by the dotted lines.

The Edison dynamos were of this type, but have for many uses been supplanted by other forms, which are mechanically more desirable, such as the form shown in Fig. 31. This has two magnetic circuits, and is also known as "iron-clad," from the fact that the poles are enclosed. This is the popular form for small dynamos, hav-

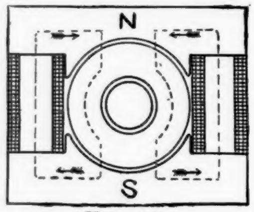

FIG. 31.

ing great mechanical strength and well protected from injury. This general design with two extra poles, one on each side, makes a four-pole dynamo, thus introducing the type known as a multipolar dynamo, illustrated by Fig. 32. Large machines are generally of this type, the number and size of poles differing greatly with different manufac-

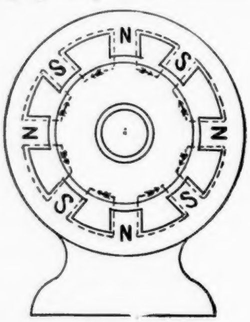

FIG. 32.

tures. This type requires less iron and wiring than do the others, weighs less for a given output, and is more easily transported and erected, all of which are of much importance when we consider the immense size of the machines now being used

The reader is advised to inspect as many different dynamos as he conveniently can, and observe carefully how they differ in form and design. In doing this, much incidental information of value will also be acquired.

As explained in the previous chapter, the armature of a dynamo is the part which generates the electric current. There are two forms commonly used, known respectively as the Gramme or ring pattern, and the drum armature. The armatures of all commercial dynamos are of either of these two kinds, or modifications of them. In the

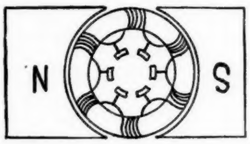

FIG. 33.

Gramme type the core is an iron ring upon which the coils are wound, as illustrated in Fig. 33. The forms for winding and the methods of connecting the coils vary widely, but may be grouped into two classes, known as *closed coil*, in which the coils are all connected, as shown in Fig. 33, and *open coil*, in which each coil performs its work entirely independent of the others.

The armature core, in all types of armatures, serves not only as a support for the wire coils, but also acts as a conductor for the magnetic lines of force in their passage from pole to pole. It is very essential that they be well adapted to perform this latter function. If made of a single piece of iron, it would, while rotating in the magnetic field, induce currents, known as eddy currents, which not only cause a waste of energy but develop heat, which would be injurious. To avoid this, the cores are made of thin sheets of soft iron, insulated from each other, and so arranged that while still providing a suitable path for the magnetic flux between the poles, no eddy currents are set up.

In the ring armature the core is made of strips of thin iron arranged in concentric rings. In the drum armature the core is made of numerous thin circular discs, insulated from each other usually with paper, and having on the circumference a suitable number of slots, as shown in Fig. 34, in which are wound the wire coils. This enables the space between the armature and the poles, known as the *air gap*, to be only great enough to prevent contact between the two. In the smaller sizes of dynamos the discs are attached directly to the shaft and secured firmly in place, usually by end plates made of brass held by nuts threaded to the

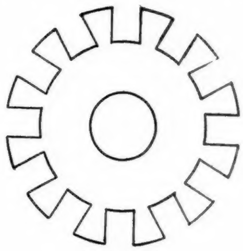

FIG. 34.

shaft. The number, size and shape of the slots cut in the discs for the coils vary widely, and likewise the wiring of the coils. This subject will receive more extended attention when the construction of some particular form of dynamo is presented. In the larger sizes of dynamo the cores of the ring, and the larger sizes of the drum type, are attached to the shaft by what are known as "spiders." They consist of a hub, which is keyed to the shaft, and has arms which are attached to the core by bolts.

The high price of coal will undoubtedly spur inventors towards perfecting oil burning furnaces for household use.

An important paper has recently been published by Dr. Selim Lemstrom, of Helsingfors, on the use of electricity as a plant fertilizer. His experiments show that for plants growing on arable land of medium quality an increase of 45 per cent. in the crops is obtainable, the better the field is tilled the greater the increase; on poor soil the effect is trifling. Certain plants, such as cabbages and turnips, do not respond to electrical treatment until after being watered. Electricity applied when the sun is shining strongly is almost invariably injurious.

WOOD TURNING FOR AMATEURS.

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I. HISTORY OF THE LATHE.

The amateur who is anxious to learn something of the art of wood turning has doubtless found, in hunting for information, that there is very little literature on the subject, when one considers the importance of the topic. The student who is fortunate in being able to attend a high school having, as one of its electives, a course in Manual Training, will obtain in the Wood Turning part of the course instruction and drill in lathe work, covering practically the ground to be covered in this series of articles. I shall, then, address myself first of all to the boy who has not been so fortunate as to have this chance.

As I have said, very little has been written on this subject, and there is in consequence little chance for arriving at conclusions as to the best method for performing any particular operation; so, also, there is a wide variation in the use of the different tools by which different operators arrive at the same results. While some turners use one tool almost entirely for a given operation, others will make use of a variety of tools. The exercises which follow are designed to give the operator command of the more commonly used tools, using each for the operations for which it is best fitted.

In the following brief history of the turning lathe, and in the subsequent articles, I have drawn from the Encyclopædia Britannica, Woodward, Hodgson, Golden, and Holtzapfel.

Before starting to study the operations of the wood turner, let us first learn something of the history of the lathe, its mechanism, and the tools to be used in the work.

HISTORY OF THE LATHE.

In its simplest form — a form which is still employed by the natives of India — the lathe consists of two upright posts, each carrying a fixed pin or dead centre, between which the stock to be turned is made to revolve by an assistant, who pulls alternately the two ends of a cord passed around it. A cutting tool is held firmly in a bar which forms a "rest"; this attacks in succession the projecting parts, and in this way the entire surface is brought to an equal distance from the central axis. In other words, the cross section becomes somewhat circular.

In its rudest form this sort of a lathe consists only of two stakes driven into the ground, through which sharpened nails are driven to support the work. The stock is revolved, as in the first case, by means of a cord in the hands of an assistant.

The first illustration of anything in the shape of a turning lathe was published in a German work in 1568, the picture showing a man at work turning a sphere. The lathe shown is of the most primitive kind, yet the picture shows a number of turned articles, such as tops, vases, balusters, spindles, etc., giving evidence of the practical results obtained by its use.

The turner stands with his back against a rail, a custom that is practiced to this day in some parts of Austria and Hungary, where the finest of children's toys are made, equal in many respects to the famous wooden ware of Tunbridge Wells. The manner by which this lathe is driven is not very clear, but from all indications it is probably driven by a pole, as there appears to be one with one of its ends inserted in the wall at the back of the lathe. The stock to be turned was rotated by means of a cord, which was wound around the work two or three times, having one end attached to an elastic pole, and the other formed like a stirrup, into which the foot of the workman was inserted.

When the foot was forced downwards the work would be rotated in the direction of the cutting tool, and the end of the pole bent downwards toward the work. When the foot reached the floor the work would cease to revolve, and the turner was compelled to draw the cutting tool back while the foot was raised, the spring in the pole drawing the stirrup up, thus causing the work in the lathe to rotate in the opposite direction.

When the pole recovered its straight form the operation would be repeated and continued until the job was completed. By this method the stock in the lathe rotated alternately, first in one direction and then in the other, and the operator was compelled to withdraw the cutting tool at every change of motion,— something that must have severely taxed his patience and skill.

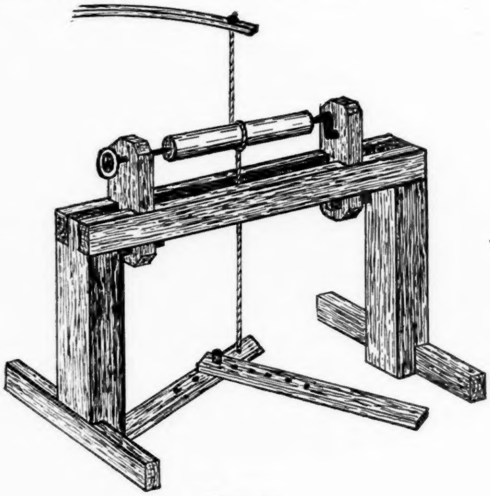


FIG. 1.

Fig. 1 shows a "dead-centre lathe" of the kind used in Europe during the eighteenth century, in which the centres are carried by "poppets," which can be adjusted to suit the length of the work, the turner giving the rotation by means of a treadle and spring lath attached to the ceiling. This lath, having immortalized itself by giving its name to the "lathe," has now almost entirely disappeared, the waste of time in its upward stroke (during which time the work revolves in the wrong direction) being a fatal objection to its use in an age in which economy in that respect is of such importance. Dead centre lathes themselves are now almost things of the past, though within their own limits,—which are of course confined to such articles as are turned on the outside only, and can be supported at the ends,—they offer a steadiness of support and a freedom of rotation which others seldom equal and never surpass. The system, however, still survives in the small lathes, or "throws," used by watch and clock makers; and for their purposes it is not likely to be superseded.

Another method of operating the early lathe was by the aid of a bow. This instrument generally had several strings to it, which were fastened to a sort of roller or pulley at their middle point. This roller had a cord attached to it which was wound several times around the material to be turned and, extending down, was fastened to a treadle under the lathe, similar to that shown in Fig. 1.

The bow was an improvement on the pole, as it equalized the force and was not so hard on the operator. The power was more uniform, enabling him to work with greater accuracy on the most delicate jobs. The bow was so constructed that it could be attached to the frame of the lathe, to the ceiling, or to the side wall, as might be most convenient.

Travellers tell us that this kind of lathe is still in use in many parts of India and China, where the itinerant mechanics carry with them their tools, including one of these lathes, and do a job of turning wherever their services may be required. It is stated that their skill in turning with the aid of this rude machine is something marvelous.

It seems to have taken a long time to develop this "treadle-lathe" into the "foot-lathe," the application to it of a fly-wheel worked by a crank and treadle having been exceptional rather than usual even in the early part of the last century, though a separate fly-wheel turned by an assistant had long previously been employed, and must have made possible the turning of heavy work which could not have been attempted without it.

The early attempts at modifying the dead-centre lathes so that articles, such as bowls, vases, and the like, could be turned without the support of what was then called the "back-centre," (corresponding to what we now call the tail-centre or dead-centre) were not very encouraging. A spindle or mandrel was after a time introduced, carrying a pulley for the lathe belt and having a rude form of screw thread at one end so that the work could be attached to it. This of course gave a rude sort of "head-stock" resembling Fig. 2. Unfortunately however the discarding of the dead-centre point and the substitution of a front bearing,—a step which was necessary in order to free

the end of the spindle, and so enabling it to carry the work,—must have been accompanied by a loss of power and an amount of unsteadiness which quite account for the tenacity with which the simple bow-lathe and the very similar "spring-bow lathe" survived.

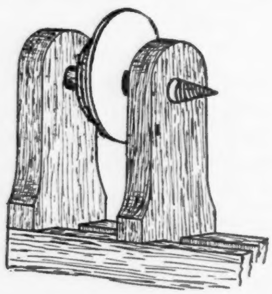


Fig. 2.

A careful study of the history of the lathe as given here shows us that the principal features essential to all lathes are, 1st., an axis of revolution for the material being operated on, and 2nd, some means for supporting and guiding the cutting-tool.

MODERN LATHES.

The types of modern lathes are as varied as are the occupations of those who use them. The mechanic, the soft-wood turner, and the amateur, for instance, differ so greatly in their requirements that lathes which would be well suited to one would be very poorly adapted, if not practically useless, to another.

Thus the professional turner of soft wood, with a lathe of which the frame and even the fly-wheel are of timber, will use a high rate of speed, sharp tools, and light cuts, thus obtaining results with which the owner of an elaborate lathe cannot at all compete. A modern mechanic's lathe, on the other hand, has very different demands made upon it. For this the greatest possible steadiness in all its working parts is the main requirement, and it is of great advantage to have the means of obtaining a slow speed, so as to be able to take the heaviest cuts which its strength and the power available warrant. As a result, timber has given way to cast iron or gun-metal or steel in almost every part of a lathe. In nearly all these modern lathes a metal spindle revolving in metal bearings determines the axis previously referred to, and as this spindle turns in one direction, the revolving wood has a movement that is steady, smooth, and continuous. The cutting tool is supported on an adjustable rest, and the speed of revolution may be varied within comparatively wide limits.

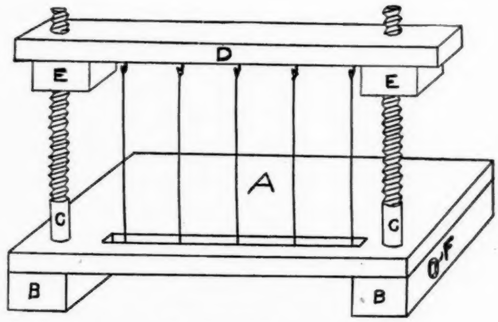
The next paper will take up the modern lathe somewhat in detail, with illustrations, and a description of its parts, together with a description of the tools to be used in the work.

An instance of non-familiarity with simple scientific facts, says Cassier's Magazine, is illustrated by an article that goes the rounds of the press once or twice annually, namely, the story of the electrified house. The article usually states that some one has discovered that everything he touches in his house—the radiators, picture frames, banquet lamps, etc.—give him an electric shock. Hence, he fears that there is some connection between the arc-light wires and the water near his residence. The electric light inspector is therefore summoned, and reports that the wires of his company are intact, and that the electricity must come from another source. It does not dawn on any of the people consulted that the discoverer of the phenomenon is unconsciously performing one of the simplest and oldest of electrostatic experiments, the shuffling of his shoes over the dry carpet raising the potential of his body to several thousand volts, which discharge at every opportunity. One may even get electrical discharges from his knuckles to the brass lock of a handbag which he may be carrying while walking on a stone pavement during cold, dry weather. But, dismissing newspaper science, it is somewhat astonishing, in view of the many ways in which in cold, dry countries electricity is unintentionally developed and manifested by sparking, that the first knowledge concerning this phenomenon did not come to the ancients in this way rather than by the attraction of light substances by amber. The explanation of this, however, may be that the scientists of bygone days did not reside in cold, dry climates.

BOOKBINDING AT HOME.

I. SEWING FRAME.

In many a household there accumulates magazines and other printed matter which the possessor does not wish to throw away, and yet does not care to go to the expense of sending them to the bindery to be bound. A satisfactory solution to such a condition is to bind them at home. Not only can home binding be done cheaply, but many times sufficient skill can be developed at the work to enable one to make fine bindings. The writer recently saw the works of a popular author which had been rebound in leather by an amateur, which showed a proficiency not common in professional work. As an occupation for inclement or winter weather, bookbinding is both interesting and profitable. The work can be continued as opportunity permits, is clean, and may be made as artistic as the purse and inclination permits. The simpler forms are quickly learned, and it is this work only which will be included in these directions, leaving the more difficult work to be learned from books already available, or under the instruction of professionals.



Sewing Frame.

As certain tools are necessary to even the most simple styles of binding, the construction of those which can be made by the amateur will first be described. The sewing frame, as shown in Fig. 1, is easily made. A large wooden clamp with screws about 15″ long, can be purchased at a hardware store for a small sum. A base-board, A, 1′ 10″ long, 14″ wide and 1″ thick, should be planed level and smooth. It is supported upon two pieces of wood, B, 14″ long, 3″ wide and 2″ thick, one at each end, which are glued and screwed to the baseboard. The heads of the screws are countersunk and covered with putty. In each of the front corners of the baseboard bore a hole, the center of which is 2½″ from the front edge and 1½″ from the ends, and of a size to snugly receive the handles of the wooden screws, C, of the clamp. The handles of the screws are then put in the holes, and ¼″ holes, F, are bored through the supports and the handles of the screws C, through which are put ¼″ bolts. This method of making the frame enables it to be taken apart and laid flat when not in use, thus requiring less space for storage.

A wooden crosspiece, D, is 1′ 10″ long, 2½″ wide and 1″ thick. Bore holes, the centers of which are 1½″ from each end, large enough to receive easily, but not loosely, the screws C. The pieces E are cut one each from the jaws of the wooden clamp, only one hole in each jaw having a thread cut in it. About 1″ of wood is left on each side of the hole. Another way to make the crosspiece D is to take the pieces of the clamp jaws having the smooth holes, cut off the ends, leaving about 1½″ of wood each side the holes; bore 1″ holes in one end of each piece, and in these holes glue the ends of a piece of 1″ round oak curtain pole 1′ 5″ long. This form possesses some advantages over the form first given. Between the screws C a long slot is cut through the baseboard A, ½″ wide and 1′ 4″ long, to receive the strings used in binding, the lower ends of which are tied through holes in flat pieces of wood 3″ long, 1″ wide and ¼″ thick, and kept in place by the tension on the string. The upper ends are tied to hooks on the lower side of the crosspiece D if the first form is used, or tied over the round rod if the second form is used. The press will be described in the next chapter.

AMATEUR WORK

63 KILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for United States, Canada and Mexico, $1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter, Jan. 14, 1902.

SEPTEMBER, 1902.

Contents

The delay in receiving material necessary to the equipment of our own publishing plant, has delayed the issuing of this number. With the excellent facilities now possessed for the work, future numbers will be issued promptly. We know how eagerly many of our readers await the receipt of the magazine, and are sorry the vexatious delays have occurred on the last two numbers. The many interesting articles now in hand will greatly increase the interest already manifested.

Many of our readers residing in the smaller towns have found it difficult to obtain the supplies necessary to make some of the things described in this magazine. For their accommodation, premiums will be offered consisting of the parts of any apparatus for which there is sufficient demand to make this premium plan feasible. On account of the expense of mailing or expressage, such offers will be confined to parts which can be sent at reasonable expense. Our readers will be expected to advise us of the parts they are desirous of obtaining in this way so that we may learn what to offer. If replies are desired a stamp must be enclosed.

Attention is called to the advertisements of prominent tool manufacturers appearing in this issue. These firms are well known to the trade as being leading concerns in their respective lines, and the tools made by them are of superior workmanship and accuracy. The readers of tnis magazine will greatly profit by obtaining the catalogues or descriptive circulars of the tools thus brought to their attention, as a working knowledge of all kinds of tools is desirable alike to professional or amateur. With such knowledge, the tools desirable for any particular work can be purchased more judiciously than would otherwise be possible.

The consul-general at Yokohama, Japan, reports to the state department at Washington that the postal authorities are considering American automobiles for transporting the mails at Tokio.

According to Electricity, the New York Central Railroad Company has formally notified Mayor Low of New York city that electricity as a motive power will be substituted for steam on all trains passing through Park avenue tunnel.

PROJECTION.

Earnest T. Childs.

I. PLANES.

Projection, or descriptive geometry, treats of the delineation of solids, that is objects having length, breadth and thickness are represented on the flat surface of a sheet of paper in such a way that their form becomes evident at a glance. The subject may be subdivided into three branches, known as Orthographic projection, Isometric projection, and Perspective. The first, which treats of the representation of objects placed in any given position by means of parallel lines drawn from given plans, elevations, etc., is the one which requires the greatest attention.

will travel through the arc of a circie as shown by points F^1, F^2 and F^3 (Fig. 2). When the plane stands at E F^3, the elevation becomes a line, AB. When it stands at E F^2, the elevation becomes A B C^2 D^2; when at E F^1, the elevation becomes A B C^1 D^1, and at E F it is the same as Fig. 1. It will be readily seen that the width of the elevation depends upon the distance that point F has moved along the arc F–F^3, and is obtained in each instance by drawing construction lines from the points in the arc up to the elevation.

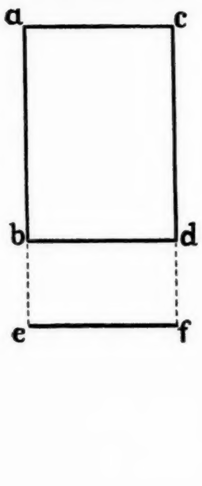


Fig. 1.

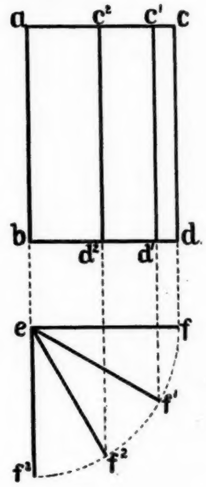


Fig. 2.

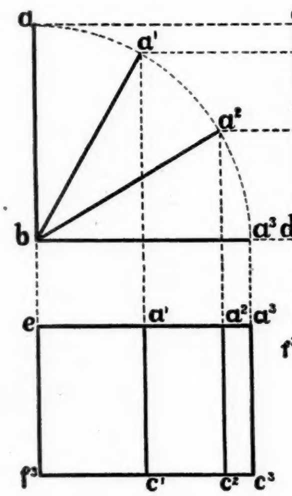


Fig. 3.

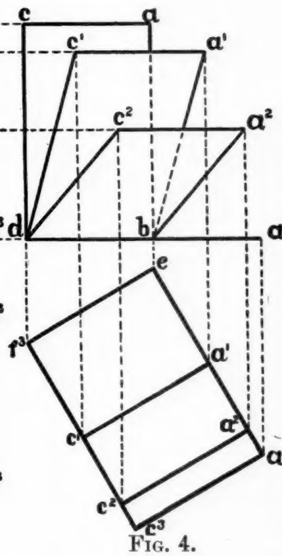


Fig. 4.

The student who has carefully followed the course in Mechanical Drawing, and completed all the plates shown therein, will be well equipped to continue his studies along the lines of Projection.

The first problem which presents itself is the projection of planes.

Assume a plane, A B C D, shown in elevation, and represented in plan by the line E F (Fig. 1). If the plane is turned on its axis A B, point F

If the plane be turned to E F^3, with elevation shown by line A B (Fig. 3), and with E F^3 as a center, and the plane be swung through arc A–A^3, the elevation will in each instance be shown by a line, B A^1, B A^2 and B A^3. The plan will be obtained by drawing perpendicular lines from points A^1, A^2 and A^3, forming figures E F^3, A^1, C^1 from A^1; E F^3, A^2, C^2 from A^2, and E F^3, A^3, C^3, which is the same as A B C D from A.

Let it be next assumed that the plan E F^3 A^3 C^3

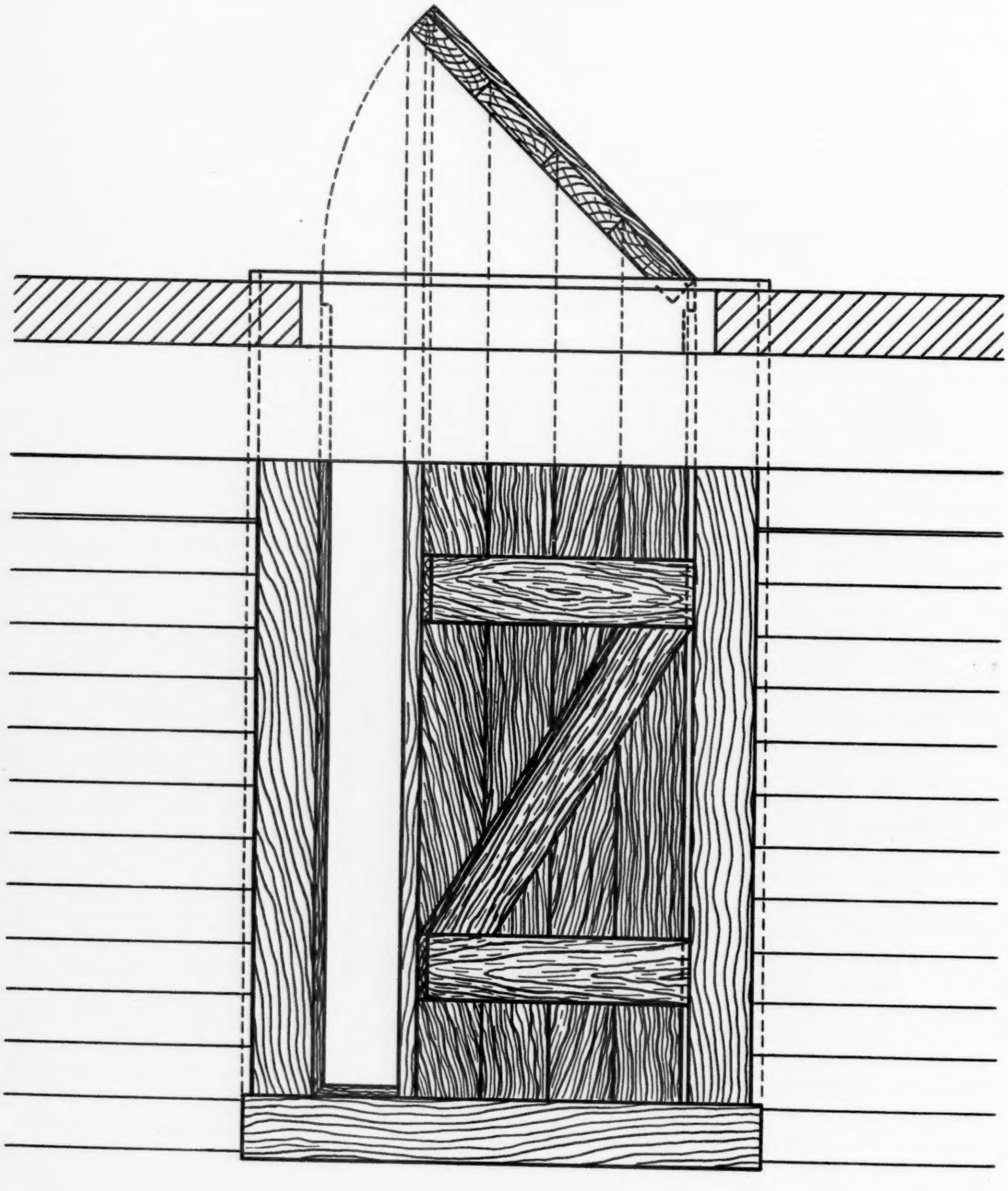


Fig. 5.

is turned at an angle, as shown by Fig. 4, and assume that the plan is to be shown as stopping at points A^1 and A^2 on arc A A^3. Plan E F^3 C^3 A^3 will be shown by line D A^3 in elevation. The plane B A^2, as shown in plan by figure E F^3 C^2 A^2, will be shown in elevation by figure A^2 C^2 B D, and plane B A^1, as shown in plan by the line E F^3 C^1 A^1, will be shown in elevation by figure A^1 C^1 B D; and plane B A, as shown in plan by E F^3, will be shown in elevation by figure A C B D.

This will be a practical application of the problem shown by Fig. 2. It will be necessary to first draw a plan showing the wall and doorway, and also showing the door swung open at 45°. Having this information, it is simply necessary to know the height of the door to be able to make the necessary drawing. The doorway will, of course, be shown of its full width and height. On account of the door being swung at an angle, it will appear foreshortened, that is it will appear

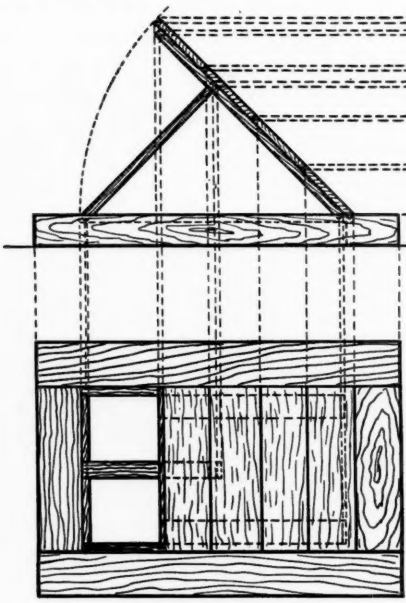


Fig. 6.

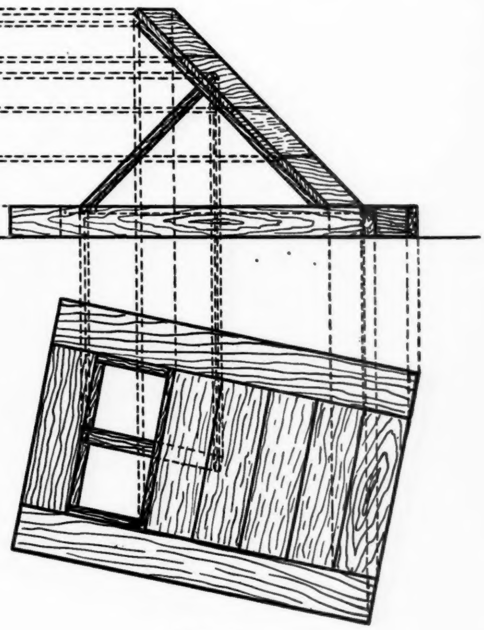


Fig. 7.

This first illustration may be taken as an index to the character of the work which is to be covered under the first heading of "Orthographic Projection." It will be immediately perceived that accuracy in construction and careful forethought are both essential to obtain helpful and satisfactory results.

Having completed the plane projection shown by Figs. 1, 2, 3 and 4, it will be advisable to make a practical application of the principles. This method will be found most helpful in fixing principles in one's memory.

Let it be supposed that we wish to represent a door of common boards, standing partly open. narrower, and parallel lines must be drawn from the plan up to the elevation to determine the appearance of the door. This is very clearly shown in Fig. 5.

A practical illustration of the application of Fig. 4 may be made by the representation of a trap door. Fig. 6 shows the trap door partially open, exactly the same as Fig. 5, except that the observer is directly above, instead of directly in front of the object. If we assume that the trap door is turned at an angle, as shown in Fig. 7, the plan view will be identical with Fig. 6; but the elevation will be materially different, as may be seen by the dotted projected lines drawn from the

plan up to the elevation. It will be readily seen that the character of the elevation view is determined entirely by the angle at which the door is turned.

In order to complete the study of planes, it is necessary to present one more series of problems. Assume that we have a square, A B C D, which in elevation will be represented by the line A^1 D. Assume that this plane be elevated so that it stands at an angle of 45° to the horizontal plane. The elevation will now be represented by the line

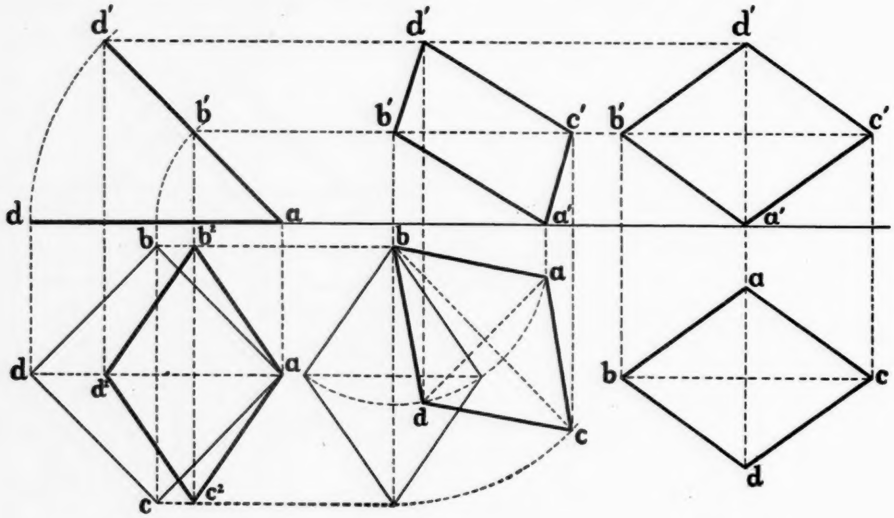


Fig. 8. Fig. 9. Fig. 10.

A^1 D^1, and by projecting downward it is found that the plan will be represented by the outline A B^2 C^2 D^2, which is diamond shaped. (See Fig. 8.)

Let the angle of 45° be maintained, and let the plane be turned through an angle of 45° as shown in the plan view of Fig. 9. By projecting upwards from points A, B, C and D, it is found that the elevation now becomes a parallelogram, A^1 B^1 C^1 D^1.—Fig. 9.

If the plane be revolved through 90° and the angle of 45° from the horizontal be maintained as before, the plan view will be represented by Fig. 10—A B C D, and the elevation will be identical, as shown by Fig. A^1 B^1 C^1 D^1.—Fig. 10.

These exercises should be thoroughly mastered by the student before attempting to advance to the representation of solids, as they contain the fundamental principles which may be applied to all line projections.

Mr. Thomas A. Edison is building a special electric car, fitted with his new storage batteries, to be used in the 500-mile reliability run in October under the auspices of the Automobile Club of America. The journey will be from New York to Boston and return.

In a gas engine, when coupled to a dynamo, the gas used to drive it for the production of electricity, it is claimed by the Electrical Review, yields three times as much light in incandescent lamps, and about 11 times as much in arc lamps, as the same amount of gas would give off if burned directly at gas jets.

The Great Northern Railway Company in England has recently made provision, at the locomotive works at Doncaster, for a new locomotive-erecting shop 580 feet long, and equipped throughout with electrically-driven machinery. The overhead electric cranes are capable of lifting a weight of 35 tons.

A RECLINING CHAIR.

John F. Adams.

Anyone making the reclining chair here described will find it a very comfortable one and requiring only ordinary skill to make. Care should be taken to lay out the work accurately so that all joints will be true and well fitted. Oak, maple or birch may be used but oak will be the most affective in appearance as well as the most durable. The four corner posts are 2¼″ square and 23¾″ long. The top ends of each are cut down ¼″ on each side and 1¾″ from the end to form the joint with the arm pieces, ½″ of the top being beveled as shown in the illustrations. The front cross piece of seat is 27″ long, 6″ wide and ⅞″ thick; 2¾″ of each end being cut down for 1″ at both top and bottom to form tenon joints with the corner pieces. The ends of the cross piece also have a ½″ bevel. The mortises for this cross piece are 4″ long and ⅞″ wide, the lower end being 7½″

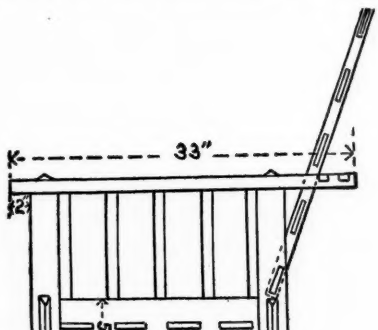


Fig. 1.

from the floor end of the corner pieces. A similar cross piece at the back is 5″ wide, the mortises for same being 3″ long and 8″ from the floor ends.

The arm pieces are 33″ long, 1¼″ thick and 5½″ wide except for 6″ at the rear ends which are cut in with curved turns to a width of 2½″, the inside edge being perfectly straight. The mortises for the corner pieces are 1¾″ square. Those at the front end are ½″ from the inside edge and 2½″ from the end, those for the rear posts being 20½″ from the front ones. When the fitting is completed, drill ¼″ holes from the inside edge of the arms through the tenons of the posts and drive dowel pins, after coating the holes with glue.

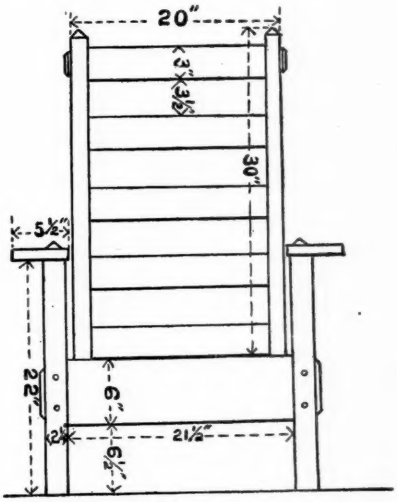


Fig. 2.

The cross pieces are also secured with ¼″ dowel pins glued in. The side cross pieces are 21¼″ long, 5″ wide and ⅞″ thick, ⅝″ of each end being cut down ½″ on each edge to form the tenons; the corresponding mortises in the posts being 4″ long and ⅞″ wide and cut through to the mortises for the front cross pieces. The mortises for the side pieces are centered in those for the front and back pieces, thus bringing them 8″ from the floor. In the upper edges four mortises are cut in each piece for the upright side pieces which are 3¾″ wide, 11″ long and ½″ thick. A piece ⅝″ wide and ½″ long is cut from each corner, making the size of the mortises 2½″ long, ½″ wide and ½″ deep. The space between each upright piece and also the posts is 1″, which can best be laid out after cut-

ting out the upright pieces. Each arm piece requires to have similiar mortises on the under side. Also on the rear upper sides of the arm pieces are cut two sockets for holding the cross piece which retains the back in position. These sockets are $\frac{3}{4}''$ wide and deep and 1″ long and 1″ apart. The outer one is $\frac{3}{4}''$ from the end.

The seat may be made in two ways; cross pieces of wood may be used or a softer seat with webbing and wire springs. If the former is chosen the cross pieces should be 24″ long, $3\frac{1}{2}''$ wide and $\frac{5}{8}''$ thick. Mortises of full size to receive the ends are cut on the inside of the side pieces 2″ from the lower edge and placed as shown in Fig. 1. If springs are used, four strips of 3″ webbing are run both across and front and back, the ends being securely held by cleats 1″ square which are screwed to the inside lower edge of the cross pieces. Short spiral wire springs are then sewed where the webbing crosses, 16 being required. The tops of the springs are then secured by additional strips of webbing or by a piece of strong canvas, the latter preferred. Allowance must be made for the depression of the springs and canvas caused by the weight of the person occupying the chair.

FIG. 3.

The back of the chair is framed as shown in Fig. 2, and attached to the rear cross piece by two strong hinges. There are devises for attaching the back but they are not generally obtainable but are preferable if they can be had as they allow the back to be brought forward over the seat which is handy when moving the chair about the house. With hinges, the back cannot be folded forward in this way. The side pieces of the back are 30″ long and $1\frac{1}{4}''$ square, the tops being beveled as shown. Five cross pieces are required 3″ wide, $\frac{1}{2}''$ thick and $18\frac{1}{2}''$ long except the top one which is 21″ long, the ends of the latter being beveled. The upper edge of the top cross piece is 1″ from the end of the side pieces, and the others are $3\frac{1}{2}''$ apart, which brings the lowest one flush with the ends of the side pieces. The mortise for the top piece is 2″ long and $\frac{1}{2}''$ wide and cut clear through the side pieces. The others are the same size but are cut only $\frac{1}{2}''$ deep and are $4\frac{1}{2}''$ apart. A piece of selected wood $1\frac{1}{4}''$ square and $22\frac{1}{2}''$ long is used to retain the back at the desired angle. The ends of this piece are cut away for 1″ on the ends so they will fit the sockets cut in the rear ends of the arm pieces. The staining and finishing should be in harmony with the other furniture of the room in which the chair is to be placed and no description of that part of the work will be given. The cushions for the chair should be purchased unless the maker has had sufficient experience to make them. They are to be had of any large furniture dealer in wide variety and varying cost.

Rear-Admiral Rodgers and the naval board, of which he is chairman, have selected a site for a government wireless telegraph station on the Navesink Highlands, says Electricity.

The first trackless trolley in America will be in operation in Franklin, N. H., says Electricity, the City Council having granted permission to a company to erect poles and wires for the system between the railroad stations. Work on the new line is to be begun at once. In Germany a line of the sort has been in operation for some time from the old fortress of Konigstein through the Biela valley, the cars running over the highway and street pavements.

Moulding and Casting Type Metal Patterns.

F. W. Putnam.

Type metal has been used with good success by the writer in the casting of small patterns, the castings obtained being generally very smooth and with very few blowholes.

The purpose of this article is to explain as clearly as possible the processes of molding and casting a simple pattern in type metal. For the pattern we will take a small car wheel. Fig. 1 is a drawing of the wheel, giving all the necessary dimensions. The pattern should be made of clear dry pine, and can be obtained at small cost from any wood turner.

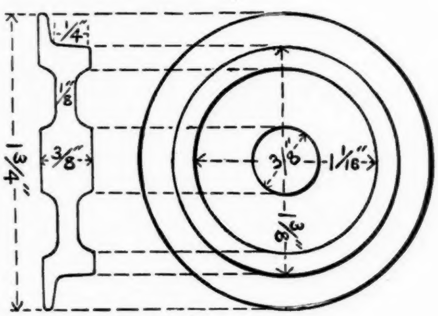


Fig. 1.

The following terms are the ones most common to founding, and will be used frequently in this article.

Flask. A flask is a frame or box that keeps the sand in place while the casting is being made, holding both pattern and sand. In its simplest form a flask may be described as a pair of boxes of similar shape and size, but without top or bottom. These boxes are prevented from separating horizontally by suitable pins, which however permit ready separation vertically. Two flat surfaces made of boards with cleats in one side complete the apparatus. Generally both boxes or "halves" are of the same depth. The lower half of the flask is called the "nowell" or "drag," and contains the holes for the pins. The upper half is called the "cope," and contains the pins which fit into the holes bored for them in the nowell. The nowell rests on the bottom boards.

The two flat surfaces spoken of above are alike, one being called the "molding board," and the other the "bottom board." The molding board is the board or plate upon which the pattern is placed while "ramming" the sand into the nowell. The bottom board is the board or plate which is placed on the top of the nowell before turning it over, and hence it becomes the bottom of the mold during subsequent molding and casting operations.

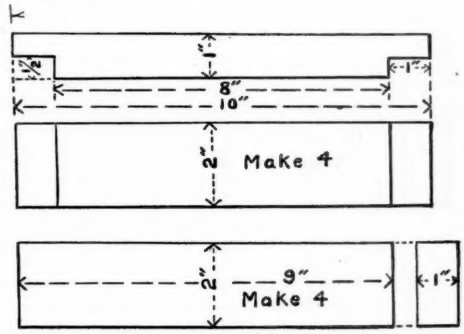


Fig. 2.

Fig. 2 shows the pieces used in making the flask. Clear well seasoned spruce should be used for this, as it will stand the moisture of the sand better than pine, though the latter may be used if spruce cannot readily be obtained. After these pieces have been cut out, cuts about 3-16 in. deep and 1-2 in. wide are made with a carpenter's gouge on the surfaces which will be the inside surfaces of the finished flask. These cuts are of use in holding the sand in place after the flask has been rammed up.

Fig. 3 shows the cope after being put together. The pieces should be fastened with 1½ in. wood screws No. 10 guage. A steel wire nail should be carefully driven down through the two side pieces at each of the points marked "X" in Fig. 3. Be sure that the nails are driven perfectly straight, otherwise there will be difficulty in lifting off the cope easily from the nowell. These nails should be either 10 penny (3 in.), or 12 penny (3¼ in.), the latter being preferable. The nowell, which is made exactly the same as the cope, must have a hole bored through each of the two sides corresponding to those of the cope, into which the nails are to fit. The hole should be ¼ in. diam. so as to give a little freedom of movement to the nails or pins as the cope sets down on the nowell. These holes should be bored clear through the sides so that the sand, which is very likely to clog the holes, can be readily punched through with a small stick.

In looking at Fig. 10 it will be noticed that four strips marked "d," two on each half of the flask, are

screwed to the sides containing the pins and tne pin-holes, being flush with the top of the cope and the bottom of the nowell. These pieces, which aid in lifting the cope from the nowell, are $\frac{3}{4}$ in. x 10 in., and are fastened with $1\frac{1}{2}$ in. wood screws No. 10. Care should be taken in making a good joint between cope and nowell. When the cope has been fitted to the nowell and found to work easily, mark plainly the corresponding surfaces of the cope and nowell in two places.

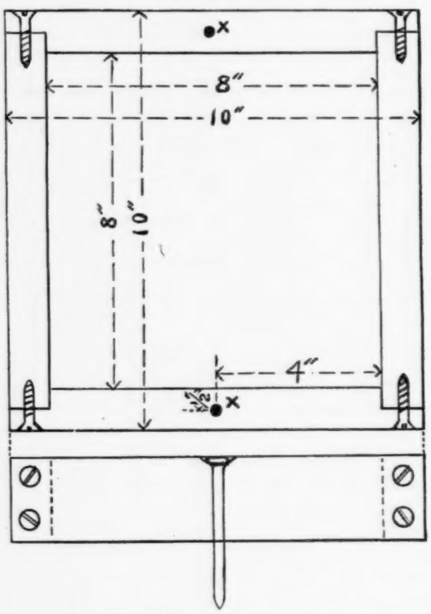


Fig. 3.

The molding board and bottom board should be made of clear dry spruce matched boards $\frac{3}{4}$ in. to $\frac{7}{8}$ in. thick. They are of the same size as the fiask, and have two pine or spruce cleats on one side, as shown in Fig. 8 to prevent the boards from warping.

The above is a description of a flask which will serve admirably for the molding of almost any small pattern, the thickness of which does not exceed $1\frac{1}{2}$ in. if the pattern is molded wholly in the nowell, or 3 in. if pattern is molded part in each half, as would be the case in a split pattern.

If the amateur does not care to take the time to construct such a flask, he can easily make something temporary to answer the purpose, but if one intends to do much molding I should advise the making of a flask of suitable size for the work to be attempted.

Fig. 4 shows sketches of a rammer. For work with this flask the rammer may be made from pine, though maple will wear much better. For light work but one is necessary. A rammer is a tool used for tamping the sand in the mold. One end has a flat rectangular point called a "peen," and the other end has a large flat surface called a "butt."

A Draw Nail is a metal piece used in drawing a pattern from the mold. A long wire nail filed down to a long point, as in Fig. 5, will answer the purpose.

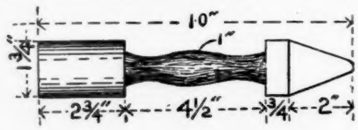


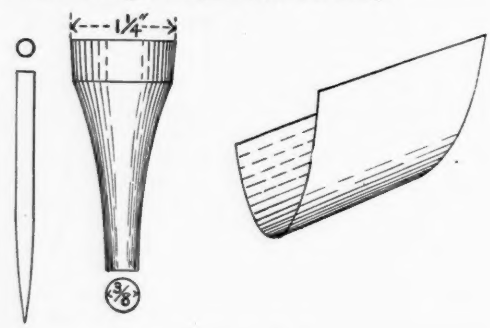
Fig. 4.

A Sprue Pin is a wooden or metal pin, used for making an opening through the cope, through which the metal is poured. Fig. 6 shows a sketch of a sprue pin which can be made of pine. It should gradually taper downwards so that it can be readily removed from the sand. The position of the sprue pin with relation to the pattern will be described later.

A Gate Cutter. Fig. 7 is a bent piece of sheet metal employed for cutting the gates from the bottom of the sprue hole to the edge of the mold.

A Vent Wire is a small wire used for making openings through the cope to provide for the escape of gases, and thus preventing blow holes in the casting.

Sand. Sand of the quality known as molding sand possesses in a large degree two desirable elements,—that of being porous, and of sticking together when moderatety moist. For small castings a fine grade of sand should be used. Fine grained sand suitable for such castings is rather difficult to obtain, so the amateur had best get the sand from a foundry.



Figs. 5, 6, 7.

Parting Sand is a general term applied to any material used to prevent two surfaces of a mold from adhering. It is usually made from sharp or burned sand.

A Riddle is a coarse sieve used for sifting sand. The hand sieve is composed of a circular frame, the bottom of which is covered with wire cloth.

The Pattern should be finished with at least two coats of shellac varnish, made by dissolving gum shellac in alchol. The first coat should, when dry, be rubbed smooth with a piece of well worn sand paper.

The second coat should be somewhat thinner than the first. This will protect the pattern so that it is not affected by the moisture of the sand, and insures a smooth surface which draws easily from the sand.

DRAFT. A small allowance for draft is always made in the pattern to aid the withdrawing of the pattern from the mold. For small patterns a taper of ⅛ in. per foot is sufficient.

MIXING THE SAND. If the sand obtained from the foundry has not been used for several days it is dry and must be mixed or "tempered" several times before being used for molding. The sand must be dampened with water and thoroughly mixed with a shovel. To test it, take a handful and press it together. If the sand be right to use it will form a lump showing the impression of the fingers, but should not be damp enough to stick much to the figers when the hand is opened.

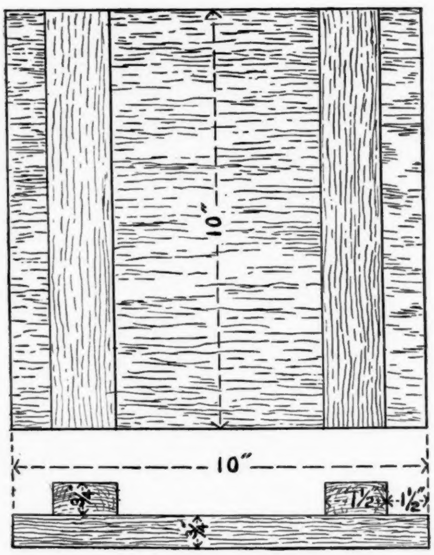


FIG. 8.

To Mold the pattern, first lay the molding board on a bench and place the nowell on it bottom up. The pattern is then laid on the molding board, as shown in Fig. 9, and the sand is sifted from the riddle into the nowell until the pattern is covered to a depth of at least ½ inch. With the hand pat the sand down evenly over the pattern, being sure that none of the molding board is left uncovered. Next fill the nowell heaping full of sand with the shovel, and "ram up" the sand, care being taken to have plenty of sand, to ram uniformly and thus avoid layers. The peen end of the rammer is used to ram into the corners and next to the sides of the nowell, the rammer being held obliquely instead of straight up and down as is the case when the butt end is used. When somwhat more than full, the upper surface is scraped off with a straight edge and the bottom board laid on.

Now comes the second step. The whole is carefully turned over and the molding board removed. Be sure that in turning over the nowell the fingers grasp both the molding board and the bottom board firmly, so that the former will not move away from the nowell.

It will be seen in looking at Fig. 10 that all of the pattern comes in the nowell; but there will be an impression made in the cope of the hub and a portion of the pattern, as shown in the shaded part a. Fig. 9 represents the nowell rammed up with the two boards in place, before the nowell has been turned over.

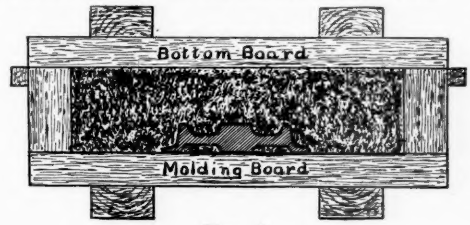


FIG. 9.

Having turned the nowell over and taken off the bottom board, dust over the whole a thin layer of parting sand. Carefully blow off all parting sand from the pattern itself, and then set up the sprue pin within about 3 in. of the pattern, and force it down into the sand for ½ in. to hold it in place. Put on the cope, being sure that the pin holes are free from sand; also that the cope lifts off readily, and that the surfaces previously marked come together. Riddle on sand until the top of pattern is covered with at least ½ in. of sand. Fill the cope with sand and ram it up as the nowell was done, being very careful not to hit the sprue pin. Fig. 10 shows the flask rammed up with the pattern and sprue pin removed.

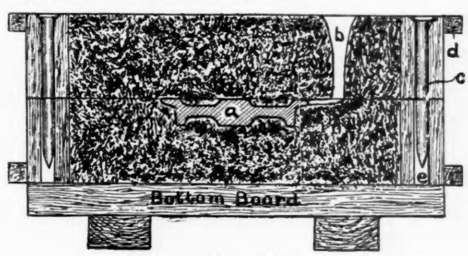


FIG. 10.

Next lift off the cope being careful to lift directly upwards. When the pins are free of the nowell, set the cope down on the bench, on one end, the top of the cope being toward the molder. If the top of the sprue pin is covered with sand, scrape it away until top is clear, aud then turn the sprue from the back, gradually forcing the sprue pin out from the mold. The

sprue pin is tapering so it will slip out easily after it is started. Be sure that the sprue hole is free from loose particles of sand. A draw pin is then driven into the middle of the top of the pattern, which is in the nowell, and the pattern loosened by gentle raps of the draw pin which is held by the left hand. The pattern is then lifted from the mold by means of the draw pin. As this particular pattern is circular in shape, it can be turned round by means of the draw pin, thus making sure that it is freed from the sand. A gate or channel about $\frac{3}{8}$ in. wide and $\frac{1}{4}$ in. deep, is now cut from the hole formed by the lower end of the sprue pin to the edge of the mold, using the gate cutter. Next run a vent wire several times through the cope, at points near the mold, so as to give vent to the gases.

Replace the cope, being sure that the marked surfaces come together, otherwise the two halves of the mold may not be directly over each other.

Pouring the Casting.

In the manufacture of type metal, one part of antimony is used to four parts of lead, the antimony hardening and whitening the alloy and causing it to contract but little while cooling. Old type metal is readily obtained at almost any printing office, and can be bought for about eight cents a pound, being about one half the price of good babbit metal. Its melting point is not very high, and it can be melted in an iron melting pot over a bunsen gas flame in from 20 to 30 minutes time. For this small pattern the metal can be melted in a medium sized skillet. When the type metal is all melted, pour a little into some of the molding sand. If it sputters badly it is too hot for pouring. If it does not sputter, but pours freely without cooling in the skillet too quickly, it is ready for use. Take a stick and quickly skim off the top of the molten metal, or slag, as it is called. Take the skillet, or whatever article the metal is to be poured from, carry it quickly to the mold, and pour the metal into the sprue hole in a steady stream, until the sprue hole is filled up with the molten metal. After five minutes the mold may be broken, and the casting examined, though care should be taken not to touch the casting with the hands until it is thoroughly cooled.

It is reported, says Railway and Locomotive Engineering, that the Boston and Maine and the Boston and Albany railroads are about to discontinue oiling their roadbeds, after a three years' trial. Several roads are ballasting the permanent way with broken stone, which, after the rain has thoroughly washed it, gives no further trouble from dust. Elsewhere the oiled roadbed is giving every satisfaction.

PHOTOGRAPHY.

A Retouching Desk.

A negative is rarely so free from defects that some retouching is not necessary. Pin holes caused by dust or air bubbles during development are the most conspicuous faults common to the amateur photographer. In a previous article the treatment of these troubles was presented. In this one, the making of a simple desk will be described, and anyone making one will find it very useful in removing the blemishes that are so frequently met with in negatives of home production.

As will be seen from the production, the desk consists of three parts connected by hinges and so arranged that they may be adjusted for light and height. The lower part consists of a frame, supporting an adjustable mirror. The mirror should be 9″ or 10″ square, with a flat frame, and may be purchased at a dealers. If made, obtain for the frame some 1″ flat picture moulding, bevel the joints and put in a piece of mirror in exactly the same way that a picture would be framed. Make a supporting frame, the end pieces being

2½″ high, ⅞″ thick and 12″ long. The side pieces are ⅞″ thick, 1″ high and 12″ long, joined to the end pieces as shown. In the centre of the side pieces, bore holes to loosely receive round headed screws which are screwed into the centre of the mirror frame. This allows the mirror to be adjusted to the proper angle to reflect the light upon the negative. On the upper side of the side pieces and in the rear half, bore ¼″ holes about ¼″ deep at a slight angle. These holes should be about 1″ apart and receive the lower ends of pieces of round wood or brass rods about 6″ long which support the centre section of desk.

The centre section is made of picture moulding about 1″ square, of the same dimensions as the lower frame. The rabbeted side of the frame is placed on the upper side however and holds a piece of ground glass, which is fastened in place by thin strips of wood. A piece of wood ¼″ thick, 3″ wide and just long enough to fit inside the frame, is placed upon the ground glass to form a support for the hand when retouching. The negative is also placed upon the ground glass, the lower side resting upon the wooden strips just mentioned. Another strip of wood about 12″ long, 2″ wide and ¼″ thick is placed upon the frame and supports the hand when working upon the upper part of the negative. Holes are bored in the under side of the side pieces of this section opposite those in the lower frame, to receive the upper ends of the supporting rods. These holes should be of the same size as the others and also at an angle.

The upper section is made of moulding and is of the same dimensions as the other frames, but the moulding may be somewhat lighter. The rabbeted side of the moulding is placed towards the centre section, and the frame is fitted with a piece of thin board. The under side of this board is covered with black paper or paint to prevent reflection or direct light from reaching the worker. On larger frames pieces of black cambric are sometimes hung between the upper and centre sections thus shutting out side light. The upper section is adjusted and secured in position by hooks and eyes. The hooks should be about 4″ long and three eyes should be put on each side of the centre frame at such an angle as to prevent the hook from slipping out except when so desired.

MODEL ELECTRIC RAILWAY.

II. The Motor Car.

The design for the motor car here given is quite plain so that those who desire to make it will have no difficulty in procuring the required materials. It consists of a wooden floor and body, type metal wheels and bearings for same made of brass strips; a small motor and clock work gearing. The method of casting the wheels is described in a separate article in this magazine, excellent wheels being easily secured if reasonable care is taken to follow the directions. The axles are straight iron wire 2″ long and about ⅛″ in diameter. Holes ate drilled in the centres of the wheels to receive the axles, the former being fixed in place with a little soft solder, put on with a blow torch. On one axle, before the second wheel is put on, is soldered a small brass pinion, which may be obtained from an old clock or purchased of any hardware dealer who carries brass gears. The size and pitch of the pinion is left to the choice of the maker as it is determined by the pitch of the gear in the connecting clockwork to be mentioned later.

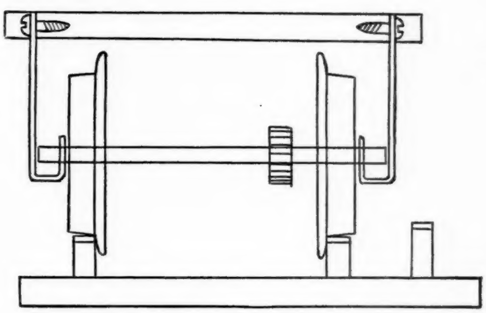


Fig. 2.

The bearings for the axles are made of strips of brass about 1-16″ thick, ½″ wide and 2″ long. In the top ends, drill two holes for the screws which are used to attach the bearings to the car floor. The lower ends are bent to the shape shown in Fig. 2, first drilling a ⅛″ hole, ¼″ from the end, to receive the axle, the end of which rests against the outside part of the bearing as shown. This arrangement allows the axle to turn freely but prevents side movement.

The floor of the car is 8″ long, 3¾″ wide and ¼″ thick. Each end is slightly rounded so that connected cars may be taken around sharp curves. A piece of wood ½″ high, ¼″ thick and 3⅜″ long is nailed ½″ from each end. The body of the car is made of thin wood (cigar boxes are well suited for it), doors and windows being cut out with knife or fretsaw. It is 3¾″ high in the centre and 2″ high at the ends. When completed, it should fit snugly over the wooden pieces nailed to each end of the floor, to which it may be attached with small screws. It should not be permanently fastened as it will have to be frequently removed so that the interior fittings may be inspected or repaired.

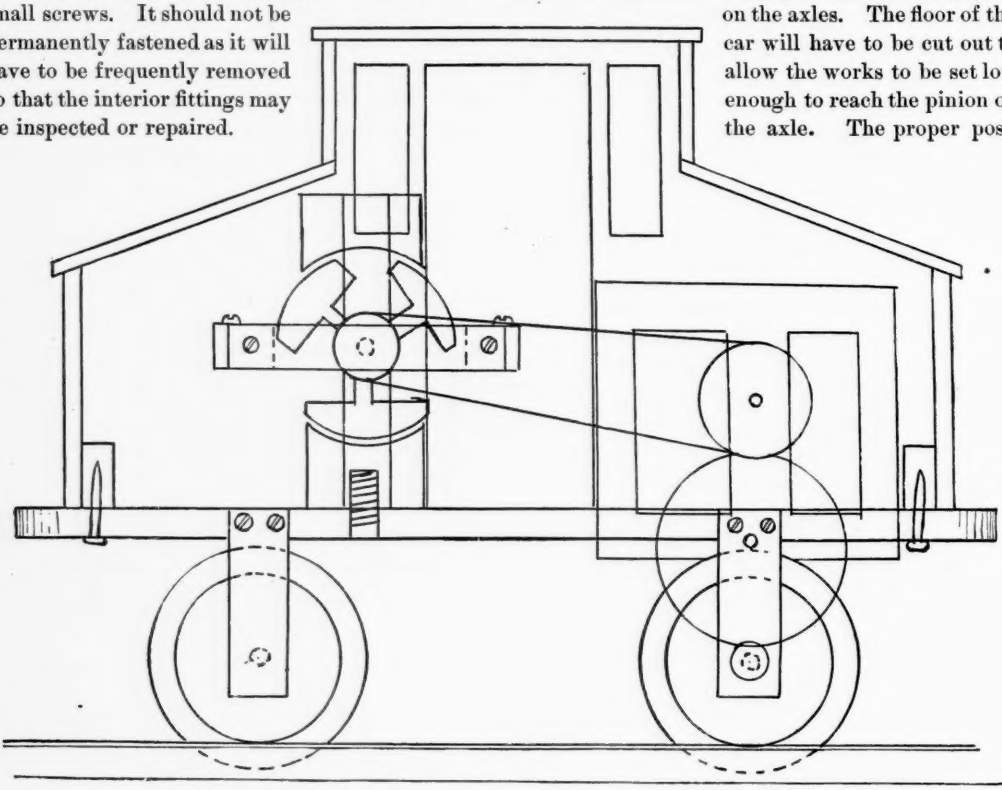


Fig. 3.

A small motor may be purchased or made. If purchased, the base which usually forms a part of small motors, should be removed and the motor then firmly screwed to the floor of the car. To the shaft, fit a wooden pulley with a face about ⅝″ wide. A good one may be made of a button hole twist spool. A flat rubber band is used for a belt which will run well on a spool pulley as described. Obtain the works of a small clock; strip it of all gears and other parts except the gear on the shaft carrying the hands and the large one connected with it. A pinion will usually be found in such a clock which will mesh all right with the large gear of the works, and this pinion should be placed on the axle of the wheels underneath the works, after the works have been correctly located. On the shaft carrying the hands fasten another spool pulley similar to the first. The works are then placed so that the two pulleys will be in line and the big gear mesh in the pinion on the axles. The floor of the car will have to be cut out to allow the works to be set low enough to reach the pinion on the axle. The proper position being ascertained, fasten the works to the floor with round-head screws and washers. The object of having these gears between motor and axle is, the speed of the motor shaft is so much greater than the required speed of the axles of the car that, if belted direct, the belt would slip and make considerable trouble or the car run too fast to stay on the track.